THE EFFECT OF SOME HERBICIDES ON WHEAT

By

Maimona Kord and Ahmed Khalil

Faculty of Science, Botany Department, Cairo University

ABSTRACT

An experiment was initiated to study the effect of 2,4-D amine, ametryne, amitrole, dual and dalapon on the protein content of the wheat and the number or ears per plant. Results showed that 2,4-D amine, ametryne, dalapon and amitrole increased the protein content of the plant. The number of ears significantly increased under the same treatments. Plants treated with dual showed decrease in both protein content and number of ears.

INTRODUCTION

Wheat is the main cereal crop which is used for human consumption all over the world. As a result of the vast increasing population, particularly in the population-densed developing countries, its production is becoming progressively short of the population need. This problem is of major economic impact in Egypt specially in the light of insufficiency of the native wheat production for local consumption.

Consequently an appreciable proportion, amounting to more than L.E., 100,000,000 in free currency per annum of the nation income is devoted to wheat import.

Efforts are therefore consistently made in order to increase the productivity of wheat in Egypt. Methods for improving the usual agricultural practices including fertilization and irrigation have been exhausted and are no longer becoming effective tools for increasing grain production. The most promising tool now contributing to increasing productivity of many crop plants is the careful and proper application of any of a variety of herbicides which are used widely now in agriculture by many methods of applying, but the foliar spray is the most important aspect of using it.

There is a considerable literature on the effect of 2,4-D on higher plants as regards the physiology, ecology and biology of this group of plants when subjected to various treatment of 2,4-D. (Lee, 1972; Rensburg and Billiers, 1978 a & b; Arkhangel'skii et al. 1982 and several others). All these reports revealed that the lower concentrations of 2,4-D may be have as growth regulators, but at higher concentrations it has antiphotosynthetic effects on all tested plants.

The main phytotoxic effects of 2,4-D seemed to be in decreased chlorophyll content (Nadakavukaren and Mc Cracken, 1977; Mc Cracken et al., 1981).

Comparative biochemical studies showed that 2,4-D induced marked changes in carbohydrate and nitrogen metabolism of treated plants (Radtseva et al., 1975).

Schroeder (1982), found that 2,4-D, dicamba and picloram applied to sugarbeet reduced percentage sucrose. All 3 herbicides also increased storage loss.

It is frequently reported that the herbicides at sub-lethal doses increase the protein content. Thus, 2,4-D increased the protein content of wheat (Khripunova, 1967 and Patil and Kale, 1975).

Ametryne is commonly used in weed control and showed, in most cases, good and promising results (Lo Giudice, 1977).

The main phytotoxic effects of ametryne lie in decreased chlorophyll contents (Ugalava and Khubytiya, 1972). Ametryne was reported to have inhibitory action on photosynthesis of higher plants, viz, wheat (Churchill and Klepper, 1979).

The phytotoxic effects exerted by amitrole were first reported by Hall et al. (1954) as a heterocyclic herbicide or defoliant which caused chlorosis, leaf abscission and growth inhibition. As regards the effect of amitrole on growth, it has been repeatedly established that amitrole induced growth inhibition in both microorganisms and higher plants. (Ali and Fletcher, 1978 and Squires, 1981).

The tolerancy and sensitivity of microorganisms and higher plants towards amitrole varied conspicuously at one and the same conc. (Ashraf et al., 1979). In this connection it may be mentioned that Hodgson and Moore (1972), working on different regional races of canada thistle, found that a group of these ecotypes responded differentially to amitrole. These differences might be attributed to the rate of uptake of the herbicide.

Comparing the effects of different herbicides on seed germination, amitrole seemed to be the least effective in reducing the germination of Urginea idica seeds (Khare and Dubey, 1979). It has been repeatedly established that amitrole interferes with carbohydrate and nitrogen metabolism (Suen et al., 1979).

It must be reported here that many investigators demonstrated that amitrole, not only inhibits chlorophyll and carotenoid biosynthesis in treated plants, but also caused damage and degradation of chlorophyll (Svensson, 1974).

The inhibitory effects of dalapon on germination and shoot elongation were evaluated by Thornton and Charles (1978). On the other hand, the foliar application of dalapon to sorghum proved to increase the seed yield with higher amounts of nitrogen, protein and carbohydrates and improved the seed quality (Santakumari and Reddy, 1980). In this connection, it was found that the increase in seed germination of lentil by dalapon was mainly attributed to the increase

in oxidizing enzymatic activities and IAA by the herbicide (Ta Furi et al., 1977).

Dalapon proved to induce variable effects on the enzymatic activities of treated organisms (Volynets and Pal'chenko, 1977).

The main phytotoxic effect of dowpon-M lies in the inhibition of chlorophyll synthesis and/or the disturbances in photosynthesis and respiration processes (Tonecki, 1975a).

The herbicide caused, as well, a decrease in the carbohydrate and hemicellulose contents of rhizomes of phragmites communis (stonov and Bersonova, 1976a). It increased the total nitrogen content of foliage of Cynodon dactylon (Srinivasan and Sakharam, 1973a).

The S-triazines are reported to be more efficient in changing the chemical composition of plant and increasing the protein content of wheat grain (Patil and Kale, 1975).

The aim of the investigation reported in this dissertation was, therefore, assessing the influence of some herbicides as a foliar spray on growth, protein content and yield of wheat plant. It was hoped that a treatment might be attained, which increases the grain yield and protein content of wheat, cheaply and effectively.

MATERIAL AND METHODS

The herbicides used in this experiment were 2,4-D amine ametryne amitrole, dual and dalapon.

Determination of Nitrogen

Nitrogen content of wheat grains at harvest was estimated by micro-kjeldahl (A.O.A.C., 1965) and crude protein content worked out.

RESULTS AND DISCUSSION

The experiment was arranged in a randomised block design with five replications. Plots were fertilized with ammonium sulphate and superphosphate.

An aqueous solution containing 50 ppm of each of the herbicides was sprayed just after anthesis, while control plants were sprayed with water.

Figure (1) shows that the spray treatments of 2,4-D amine, ametryne, amitrole and dalapon significantly increase the protein content of wheat grain over control.

The increase in protein content as a result of treatment with 2,4-D has been reported by many workers (Kedrev and Tjankova, 1962; Huffaker et al., 1967 and Patil and Kale, 1975). These chemical might have increased the protein content by stimulating the pathway of protein synthesis.

Figures 2 and 3 show that treating plants with the mentioned herbicides showed a significant increase in the number of ears per plant, except dual which caused significant decrease in it.

The effect of the herbicides on the yield, calculated as the weight of 100 grains, followed the same pattern as number of ears and protein content of the grains.

The increase in grain yield recorded in the present investigation was in agreement with the finding of El-Shaarawi (1971), working with barley.

Singh et al. (1972) also reported that enzyme activities like nitrate reductase, glutamicpyruvic transaminase, amylase, phosphorylase and adenosine triphosphatase were generally stimulated by triazine treatments. However, detailed studies on mechanism of action of these herbicides and influence on protein synthesis is needed.

REFERENCES

Ali, A. and Fletcher, R.A. (1978). Phytotoxic action of glyphosate and amitrole on corn seedlings. Canadian J. Botany, 56: 2196-2202.

A.O.A.C. (1965). Journal of Association of Official Agricultural Chemists ed. by William Horwitze. 48: 401.

Arkhangel'skii, N.S.; Kostrikin, V.M.; Gruzdev, L.G. and Luzik, L.V. (1982). Yielding capacity of different fodder beet cultivars and protein and amino acid content in the roots after using 2,4-D as a growth regulator. Izvestiya: Timiryazevskoi Sel'skokhozyaistvennoi. Akademii. 2: 40-47.

Ashraf, N.; Bhatia, R.K. and Sen, D.N. (1979). Effect of certain weedicides on weeds and cultivated crops of indian arid zone. J. Indian Bot. Soc. 58: 277-280.

Churchill, K. and Klepper, L. (1979). Effect of ametryne on nitrate reductase activity and nitrate content of wheat Pesticides Biochemistry and Physiology. 12: 156-162.

El-Shaarawi, A. (1971). Effects of 2-chloroethyl trimethyl ammonium chloride on the growth of some Egyptian wheat and barley varieties. Ph.D. Thesis, Faculty of Agric., Cairo University.

Hall, W.C.; Johnson, S.P. and Leinweber, C.L. (1954). Aminotriazole. a new abscission chemical and growth inhibitor. Texas Agric. Exp. Sta. Bull. 789.

Hodgson, J.M. and Moore, H.D. (1972). Stomata variations in Canda thistle and response to herbicides. Weed Sci. 20: 68-70.

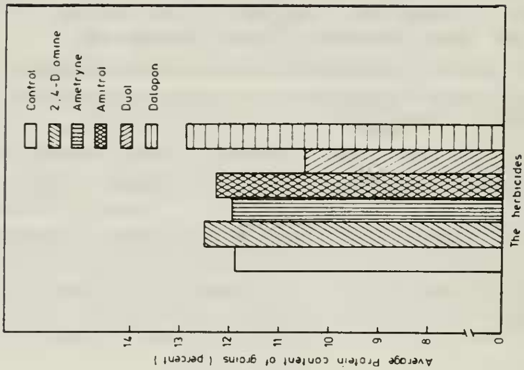

Fig (1) Effect of some herbicides on protein content of grains

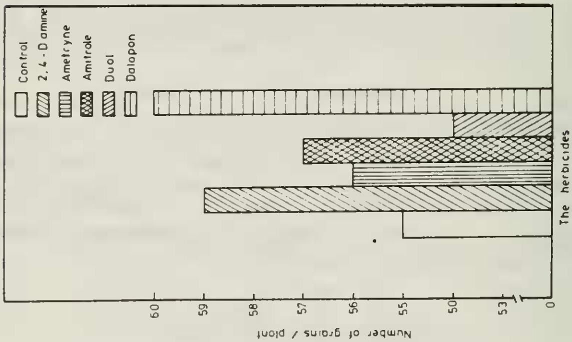

Fig (2) Effect of some herbicides on the number of grains per plant

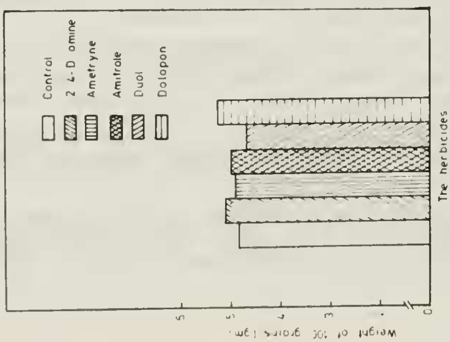

Fig (3) Effect of some herbicides on the weight of grains

Huffaker, R.C.; M.D. Miller; K.G. Baghott. F.L. Smith and C.E. Schaller. (1967). Effect of field application of 2,4-D and iron suppliments on yield and protein content of wheat and barley and yield of beans. Crop Sci. 7: 17-19.

Khare, L.J. and Dubey, P.S. (1979). Effect of herbicides on seed germination and seedling growth of the weed Urginea indica. Comp. Physiol Ecol. 4: 225-228.

Kedrev. T.G. and L.A. Tjankova (1962). Studies on rate of 2,4-D in protein content of wheat seeds Fiziol. Rust. 19: 425-427.

Khripunova, L.C. (1967). Effect of 2,4-D on nitrogen and gluten content in spring wheat seeds. Khin. selsk. Khoz. 5: 760-761.

Lee, T.T. (1972). Changes in indoleacetic acid oxidase isoenzymes in tobacco tissues after treatment with 2,4-D. Plant Physiol. 49: 957-960.

Lo Giudice, V. (1977). The phytotoxicity of some herbicides in preliminary experiments in which they were applied in the irrigation water. Annalidell' Instituto sperimentale per L'Agrumicoltura. 9/10: 129-135.

McCracken, D.A., Ort, D.R. and Nadakavukaren, M. (1981). The effects of 2,4-D altered chloroplast development on photosynthesis. Physiologia Plantarum. 52: 285-291.

Nadakavukaren, M.J. and McCracken, D.A. (1977). Effect of 2,4-D on the structure and function of developing chloroplasts. Planta. 137: 65-69.

Patil, V.A. and V.R. Kale (1975). Yield and protein content of wheat varieties (Kalyansona and NI-5642) as influenced by sublethal doses of herbicides. Qual. Plant. Pl. Fol. Hum. Nutr. XVU. 2: 187-192.

Radtseva, G.E.; Radtsev, V.S.; Girfanov, V.K. and Ryakhovskaya, N.N. (1975). Effect of chlorocholine chloride and herbicides on nutrient metabolism and productivity of spring wheat. Regulyatsiya Otlozheniya Zapasnykh vesnichestv; Produktivnost' Rastenii Ufa, USSR: 103-121.

Rensburg, A.J.J. Van and Billiers, O.T. DE. (1978b). Effect of 2,4-D and MCPA on α -amylase and cellulase activity in roots of Raphanus raphanistrum. Agroplantae. 10: 5-7.

Santakumari, M. and Reddy, C.R. (1980). Use of dalapon to improve the nutritive value of sorghum seeds. Seed Res. (New Delhi) 833-37.

Schroeder, G.L. (1982). Herbicides in sugarbeets: spray drift; residues in soil; and chlorophyll fluorescence. Dissertation Abstracts International, B. 42,10,3908.

Singh, B., M.T.Wu and D.K. Salunkhe (1972). The use of chemicals to increase the leaf and seed proteins by certain crops. Pl.Fd. Hum. Nutr. 2: 171-184.

Squires, N.R.W. (1981). The autumn use of aminotriazole for the control of Agropyron repens. Conference United King. Association of Applied Biologists. 187-195.

Srinivasan, P.S. and Sakharam, R.J. (1973a). Effect of dowpon on nitrogen fractions of Cynodon dactylon pers. Madras Agric. J. 60 : 1751-1755.

Stonov, L.D. and Bersonova, K.A. (1976a). The carbohydrate content in reed rhizomes under the residual effects of herbicides. Khimicheskie Sredstv Zashchity Rastenii. 5; 131-132.

Suen, R.S.K.; Lenoir, J.A. and Ibrahim, R.K. (1979). Effect of amitrole on growth and organic nitrogen metabolism in soybean cell culture. Zeitschrift fur Pflanzen-physiologie. 93: 31-43.

Svensson, J.A. (1974). Growth and yield of cultivated plants treated with herbicides. 1. Treatment with aminotriazole. Swedish J. of Agric. Res. 4: 177-189.

Ta Furi, F.; Businelli, M.; Scarpon, L. and Marucchini, C. (1977). Stimulation of the activity of the JAA-oxidising enzyme system in lens culinaris roots by dalapon and perfluidone. J. Sci. Food Agric. 28: 180-184.

Thornton, M.S. and Charles, A.H. (1978). Dalapon resistance at an early seedling stage in Lolium perenne. J. of the Britich Grassland Soc. 33: 137-138.

Tonecki, J. (1975a). Changes of respiration intensity and chlorophyll content in needles of Norway spruce seedlings treated with 2,4,5-T and dalapon, Acta Agrobotanica. 28: 177-195.

Ugalava, N.A. and Khubytiya, R.A. (1972). Effect of diuron and atrazine on some phytotoxic reactions of perenial crops. Agrokhimiya. I: 114-117.

Volynets, A.P. and Pal'chenko, L.A. (1977). Enzymatic oxidation of IAA in lupin plants upon treatment with herbicides. Fiziol. Rast (MOSC), 24: 555-559.